Lands of Contrast, Diversity, and Beauty

by Jim Rorabaugh and
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A rare dusting of snow in the normally hot, dry Sonoran Desert
Corel Corp. photo

Despite their popular image as hot, dry, virtually lifeless wastelands, deserts support a deceivingly rich level of plant and animal life with a high degree of biological diversity. But just what is a desert?

Mark Dimmitt of the Arizona-Sonora Desert Museum (see the following article) has coined a concise nontechnical definition of a desert as "a place where water is severely limiting to life most of the time." Deserts generally receive less than 10 inches (25 centimeters) of annual precipitation and are characterized by high evaporation rates. As a result, desert plants and animals must be especially efficient at capturing water and thrifty in its use. To further complicate matters for living things, precipitation is often highly variable in terms of time and place. For example, in the Sierra del Rosario of the Gran Desierto in the state of Sonora, Mexico, no measurable precipitation fell during a 34-month period in the early 1970s. In contrast, rainfall from a single torrential storm event can exceed the mean annual precipitation. Other characteristics that help define deserts include high maximum temperatures and daily temperature variation, low soil fertility, and extremely low cover by perennial plants.

Deserts cover up to one third of the earth's land surface. In western North America, 386,000 square miles (one million square kilometers) are considered desert. The United States has four desert regions: the Great Basin, Mojave, Sonoran, and Chihuahuan (see map). In the Great Basin Desert, snowfall and freezing temperatures are common in winter, whereas frost occurs only 2 to 5 percent of the time in the Mojave and Chihuahuan deserts and 1 percent or less of the time in the Sonoran Desert.

Although deserts are harsh environments in many ways, species richness can be high. In a recent assessment (*Terrestrial Ecoregions of North America: A Conservation Assessment,* T.H. Ricketts *et al.*, Island Press, 1999) of biodiversity in 116 U.S. and Canadian biomes (major life zones of interrelated plants and animals determined by climate), the Chihuahuan Desert had the greatest diversity of birds, mammals, reptiles, and butterflies, and placed eleventh in vascular plant diversity. The Sonoran Desert ranked second in avian species diversity and third in mammalian diversity. All four North American deserts also had high rates of endemism (where species have locally restricted ranges) as well, which reflects specialized adaptations to habitat niches.

Contributing to the diversity of desert organisms are those species that live in pockets or oases of less arid environments. Riparian or streamside environments, in particular, support an array of species found nowhere else in desert regions. The Rio Grande and Pecos River of the Chihuahuan Desert, the San Pedro and Colorado rivers of the Sonoran Desert, and the Mojave River of the Mojave Desert contribute enormous

diversity to these otherwise arid environments. Also important are mountain tops or "sky islands," and in some cases deep, shady canyons, that support chaparral, woodlands, or other communities that are relics of more temperate periods.

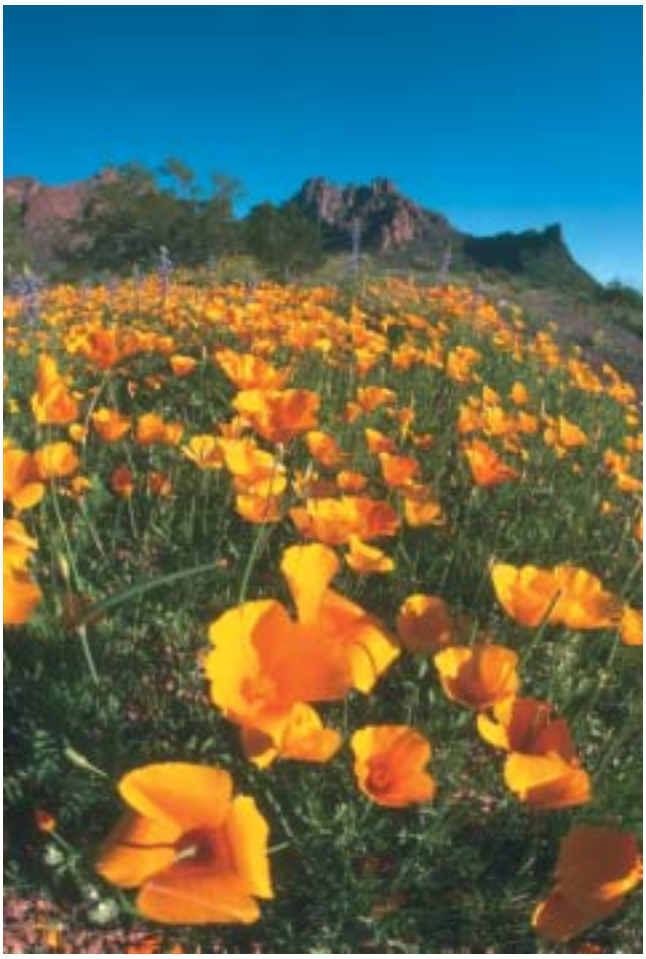
Plants and animals are often exquisitely adapted to living in the desert. The concept that species struggle to survive in the desert is inaccurate. Desert residents employ various behavioral and physiological adaptations to thrive in this harsh environment. Some species simply avoid aridity by living in riparian habitats, or by being active or growing only during the desert's brief wet periods. For example, more than 40 percent of desert plants are annuals that germinate and grow only when enough rain has fallen. Spadefoot toads *(Scaphiopus* and *Spea* spp.*)* and some other amphibians wait out the desert's heat and aridity in subterranean retreats until summer rains create standing water for breeding and feeding. Sometimes they must wait a year or more for the rains to come. Other species are simply adapted to living with aridity. Plants, for example, employ a variety of strategies to minimize evaporative water loss: some drop their leaves in dry periods; some develop succulent stems, leathery leaves, or tubers that store water; and others lack leaves entirely.

Our deserts are relatively intact and undisturbed compared to most other North American ecosystems, many of which have been logged, farmed, urbanized, or otherwise changed in many ways by human activities. The harshness of the desert, and the perception that deserts are wastelands, kept people away for a long time. But deserts did not escape human influence even historically, and today humanity affects even the most remote desert locales. Urbanization and agriculture have consumed large tracts of desert in recent years, such as in the rapidly growing urban centers of Phoenix and Las Vegas, and certain military activities have degraded thousands of acres. Even where large-scale habitat loss has not occurred, off-road vehicles and other forms of recreation, cattle and sheep grazing, roads and canals, introduced invasive plants, and a myriad of other human-caused problems can degrade and fragment desert ecosystems.

Desert soils and their biota are fragile, often overlooked resources. Crypto-biotic crusts, which are soil communities of lichens, algae, and mosses, are very important. They benefit native plant and animal communities by stabilizing desert soils, contributing nutrients, and increasing water infiltration. These crusts are especially well-developed in desert soils but are easily destroyed by cattle grazing, off-road vehicles, and other sources of surface disturbance. Once destroyed, the crusts may take centuries to fully recover. Tank tracks from General Patton's World War II military training are still visible in the Mojave Desert. Cryptobiotic crusts have been observed growing in undisturbed soils around the tracks, but 60 years

Map adapted from "Deserts" by K. Bruce Jones, in* Inventory and Monitoring of Wildlife Habitat, *U.S. Department of the Interior, 1986.

Pronghorn in Great Basin desert
Photo by Curtis Carley/USFWS



If enough rain falls, desert wildflowers can erupt from seeds that may have been produced years ago.
Corel Corp. photo

later, the crusts are still absent from the tracks themselves. The disturbance of desert crusts by vehicular activity results in erosion and the movement of particulate matter, sometimes far beyond its source area. In some areas, these wind-blown particulates are a hazard to human health; in others, newly formed sand dunes bury existing habitats and alter biotic communities.

Historically, mining and cattle grazing were the primary uses of desert lands. Cattle were introduced over 300 years ago, but were not common on the landscape until the railroads arrived and encouraged large-scale ranching in the late 1800s. Cattle have had a profound effect on desert scrub communities, including the depletion of native grasses, introduction of nonnative plants, destruction of cryptobiotic crusts, and compaction of soils. Changes in plant communities have led to decreased diversity and numbers of lizards and other wildlife. Evidence of mining in the desert is often historical, but interest in "hard rock" minerals, especially gold, has undergone a resurgence in some areas due to new technologies that can extract minerals from old tailings or other low-yield sources.

Invasive nonnative plants, such as red brome *(Bromus rubens)*, filaree *(Erodium cicutarium)*, and split grass *(Schismus* spp.*)*, are now common and widespread across the North American deserts. Bufflegrass *(Pennisetum ciliare)*, a perennial bunch grass from Africa introduced as cattle feed, has been planted in rangelands in Texas, occupies more than 2 million acres in Sonora, Mexico, and is invading other desert lands in Arizona and Texas. Its expansion to the north and into higher elevations has been limited by winter cold. However, the "frio" variety, recently released in Texas, tolerates colder climates and is sure to pose an even greater threat to the desert's biodiversity. Another African invader, Sahara mustard *(Brassica tournefortii)*, has in recent years spread rapidly across the Mojave Desert in California and in sandy areas in the Sonoran Desert.

In abundant rainfall years, nonnative annual plants can be dense enough to carry fire when they dry and cure. The perennial bufflegrass can carry fire during any dry period. Most native species are poorly adapted to fire, because fire was historically absent or very rare in many parts of North American deserts. Fire fueled by nonnative plants is converting scenic stands of columnar cacti and leguminous trees in the Sonoran Desert, and creosote and yucca in the Mojave Desert, to grasslands dominated by nonnative annual grasses and herbs.

Some human impacts to the desert are more difficult to detect by casual observation. Vanadium, a by-product of oil production in the Central Valley of California, has increased in air samples collected in the northern Mojave Desert. In Death Valley National Park, sulphur compounds have been found to occur at elevated levels in tree rings dating to the years following World War II. High levels of heavy metals have been detected in some desert tortoises. At this time, we do not know how these elements will affect biological diversity in the desert.

Some of the most contentious issues in the desert southwest center around the development and use of water. In the southwest, we have an old saying: "Whiskey's fer drinkin' and water's fer fightin' over." As a scarce commodity, water in the desert has been the subject of considerable "fightin' " for a long time. Virtually every major river in our deserts has been dammed and diverted, many have been channelized and lined with levees, and others have been pumped dry.

Our desert rivers and streams are also awash in nonnative fishes, invertebrates, amphibians, and plants. As a result, a high percentage of native riparian species in the deserts are in some danger of extinction. Most of the native fishes are listed as threatened or endangered, and the roster of other listed and candidate riparian species continues to grow.

Despite considerable threats to desert biodiversity, many public and private agencies and institutions have stepped up to the plate to meet the challenge of conserving arid land resources. Lands administered by the Bureau of Land Management support numerous sensitive habitats and species, although the Department of Defense, National Park Service, Fish and Wildlife Service, and Forest Service also manage key areas of biodiversity. The Navajo, Hopi, Tohono O'odham, and many other Native American Tribes also are stewards of desert lands across the West. State parks and wildlife areas, particularly in California and Texas, have protected key areas. Many private groups and individuals, too numerous to mention here, have been instrumental in bringing about needed changes in land management and in preserving special places in the desert. Some ranchers and other landowners are modifying their activities to conserve native plants and animals as well. The articles that follow illustrate some of the many programs and projects that have contributed to the preservation of the unique species and subtle beauty that characterize our North American deserts.

Death Valley, California, in the Mojave Desert
Corel Corp photo

(At right) Florida scrub jay
USFWS photo

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Florida's Desert

by Susan D. Jewell

Most people are familiar with the deserts of the American southwest. But who ever thinks of a desert in Florida?

In scattered patches, particularly across central Florida, there are sandy scrub habitats so dry that only desert-like animals can survive. The best example is the Lake Wales Ridge, 100 miles (160 km) long and up to 25 miles (40 km) wide. It is a remnant of the prehistoric shoreline, left after wind and waves piled the sand into high dunes. Now the sand lies hundreds of feet thick below the ground. Rainfall percolates through these deposits so quickly that plants and animals must survive on little moisture. Nutrients also quickly leach through.

Some of the animals found there, such as the Florida scrub-jay *(Aphelocoma coerulescens)* in the photo above, are similar to ones found in the southwest desert. Mole and sand skinks, scrub lizards, and many fossorial (digging) insects have adapted to life on the shifting sands. Agaves and thorny plants also thrive here.

The Lake Wales Ridge has one of the highest concentrations of endemic species in North America, including 22 listed plants and 4 animals.